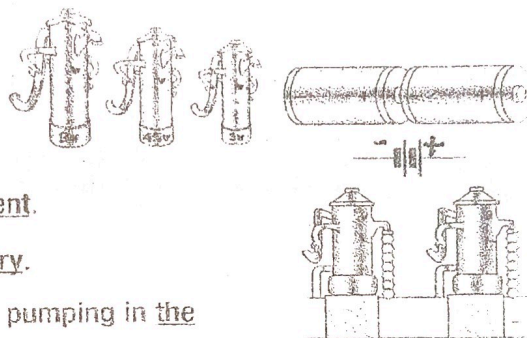
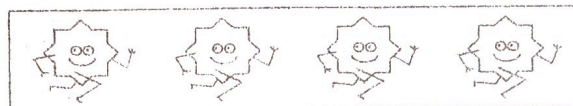


CIRCUIT DIAGRAMS AND COMPONENTS

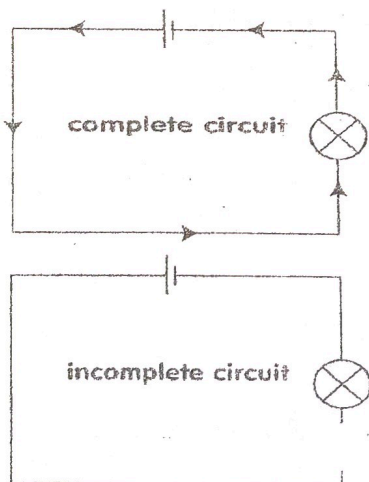
ELECTRIC CURRENT

- An electric current is a flow of charge.
- Charges can be made to flow using a cell or a battery.
- Cells and batteries act as charge pumps.
- They give charges energy.
- Several cells connected together can produce a larger current.
- Several cells connected together like this are called a battery.
- Care must be taken to connect the cells so that they are all pumping in the same direction.



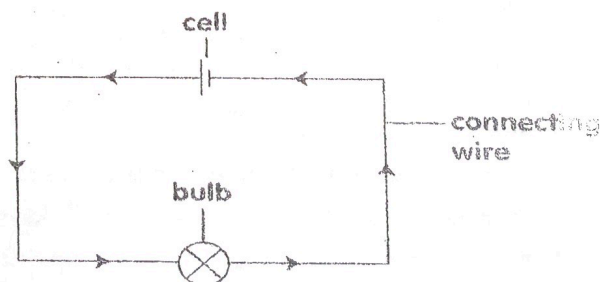
SIMPLE CIRCUITS

- Charges can flow through wires in the same way that pumped water flows through pipes.
- The wires, cells, bulbs etc must be connected to form a complete loop (or circuit).
- If there are gaps the circuit will be incomplete and no current will flow.

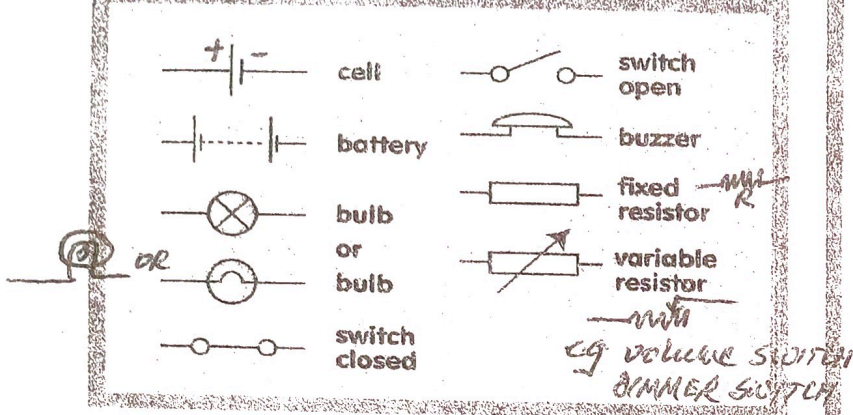


CIRCUIT DIAGRAMS

- Instead of trying to draw diagrams of the actual components in a circuit we use circuit diagrams containing easy-to-draw symbols for the components, as shown in the diagrams below.

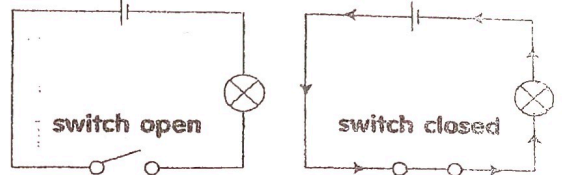


CIRCUIT SYMBOLS YOU SHOULD KNOW



SWITCHES

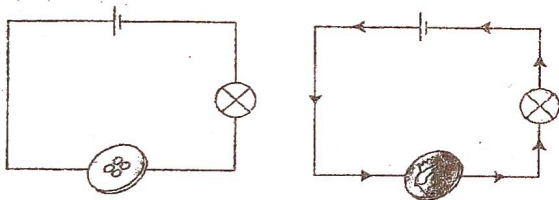
- Switches behave like drawbridges, making a circuit complete when they are closed and incomplete when they are open.



- When the switch is open the circuit is incomplete, current will not flow and the bulb is turned off.
- When the switch is closed the circuit is complete, current will flow and the bulb is turned on.

CONDUCTORS AND INSULATORS

- Metals are good conductors of electricity. They allow charges to move through them easily.
- Non-metals are mainly poor conductors (or insulators). They do not allow charges to move through them easily.



RESISTORS

- Resistors are used to control the size of current flowing through a circuit.
- With no resistor in this circuit the current is large and the bulb glows brightly.
- If a resistor is connected into the circuit a smaller current flows and the bulb is dimmer.
- If a variable resistor is connected into the circuit the size of the current flowing can be altered.
- The variable resistor is controlling the brightness of the bulb.



QUICK TEST

- What is a battery?
- What does a battery do in a circuit?
- In order that a current will flow a circuit must be
- Name one material that is a) a conductor and b) an insulator.
- What does a resistor do in a circuit?
- What is a variable resistor?

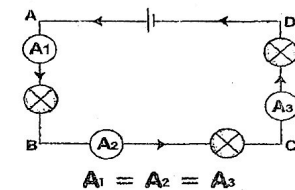
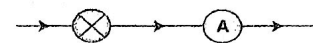
- Several cells connected together.
- Push charge around.
- Complete
- a) Any metal, b) plastic.
- Controls the size of current that flows.
- A resistor whose resistance can be changed.

CIRCUITS - CURRENT AND VOLTAGE

CURRENT (I) = number of charges passing a point in a circuit in 1 second

MEASURING CURRENT

- We measure current with an ammeter.
- We measure current in amperes or amps (A).
- The size of a current is the rate at which charge is flowing.
- Ammeter 1 is measuring the current flowing through AB.
- Ammeter 2 is measuring the current flowing through BC.
- Ammeter 3 is measuring the current flowing through CD.
- All three ammeters show that the same current is flowing in all parts of the circuit.
- This proves that current is not used up as it flows around a circuit.



AMMETERS - CONNECTED IN SERIES IN A CIRCUIT

ENERGY AND CIRCUITS

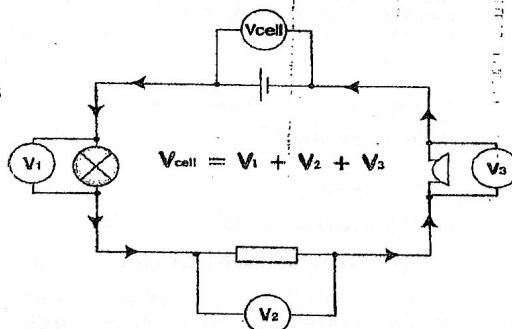
- Charges are given energy as they pass through a cell or battery.
- The higher the voltage of a cell or battery the greater the amount of energy given to the charges.
- We can measure the energy given to the charges by the cell or battery using a voltmeter.
- The voltmeter is connected across the cell. (PARALLEL)
- As charges flow around a circuit they give away the energy they were given by the cell/battery.
- This energy is transferred into other forms by the components in the circuit.

Examiner's Top Tip

Ammeters are connected in series. Voltmeters are connected in parallel.

V_{cell}
This voltmeter is measuring the energy given to charges by the cell.

V_1
This voltmeter is measuring the electrical energy changed into heat and light energy by the bulb.



V_3
This voltmeter is measuring the electrical energy changed into sound energy by the buzzer.

V_2
This voltmeter is measuring the electrical energy changed into heat energy by the resistor.

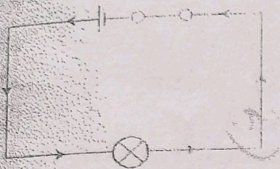
- A bulb transfers electrical energy into heat and light energy.
- A resistor transfers electrical energy into heat energy.
- A buzzer transfers electrical energy into sound energy, etc.

MEASUREMENT OF "P.D" : voltmeter ; units - volts
RESISTANCE : o/p. to flow of charge (R is $\frac{1}{I}$) units Ohms (Ω)

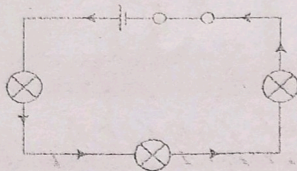
SERIES AND PARALLEL CIRCUITS

There are two types of circuit: series circuits and parallel circuits.

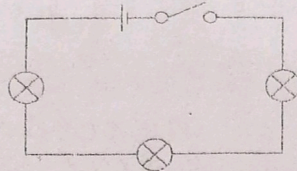
SERIES CIRCUITS



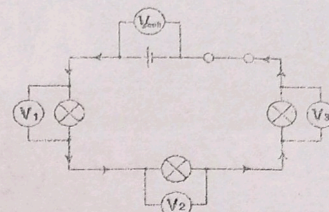
No branches only one path to follow.



Same current in all parts.



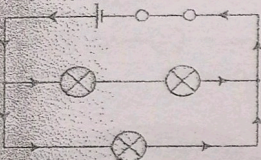
Switch open — no current anywhere in the circuit.



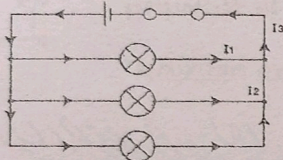
$$V_{\text{cell}} = V_1 + V_2 + V_3$$

- These have no branches or junctions
- They only have one path for the current to follow
- Can be turned on and off by a single switch anywhere in the circuit: 'one out all out'.
- They have the same current flowing in all parts of the circuit.
- The sum of the voltages across all the components is equal to the voltage across the cell or battery.

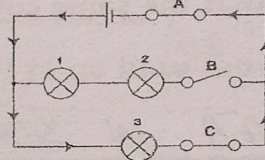
PARALLEL CIRCUITS



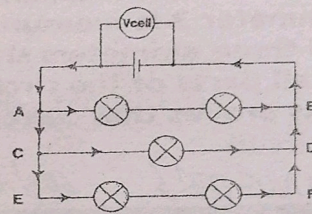
Currents may be different in different parts of the circuit circuits have branches and more than one path to follow.



Different currents but currents flowing into junction = currents flowing out i.e. $I_1 + I_2 = I_3$



Opening switch B turns off bulbs 1 and 2 but current can still flow through bulb 3. Bulb 3 can be turned on and off with switch C. Switch A can turn all three bulbs on and off.



$$V_{\text{cell}} = V_{AB} = V_{CD} = V_{EF}$$

- These have branches and junctions.
- There is more than one path for the current to follow. There is choice.
- Switches can be put into the circuit to turn on and off all or just part of the circuit.
- The size of currents flowing in different parts of the circuit may be different.
- However, the current flowing into a junction must be equal to the current flowing out of the junction.

QUICK TEST

1. What is an electric current?
2. How do we measure the size of an electric current?
3. In what units do we measure electric current?
4. What is not used up in an electrical circuit?
5. What is carried around a circuit by the charges?
6. What does a voltmeter measure when it is connected across a) a cell and b) a bulb in a circuit?

6. a) The energy given to the charges, b) The energy changed into heat and light by the bulb

1. Flow of charge
2. Ammeter
3. Amperes or amps
4. Current
5. Energy
6. a) The energy given to the charges, b) The energy changed into heat and light by the bulb

Examiner's Top Tip

It is really important to understand the properties and differences of series and parallel circuits and be able to draw examples of each. Practise drawing circuits containing five or six bulbs with lots of switches and then explaining which switches control which bulbs.